Reviewer#1

Review of the manuscript 'Near real-time atmospheric and oceanic science products of Himawari-8/9 geostationary satellites over the South China Sea'

Peter Kuma

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Dear editor and authors,

The authors present near-realtime geosynchronous satellite products derived from the Himawari 8 and 9 satel-lites over the South China Sea. This is an important dataset with many subsequent uses. The authors mostly use established algorithms to derive various conventional cloud, temperature, water vapour, vegetation and snow quantities. They evaluate their results against existing MODIS products and the ERA5 reanalysis. I found the manuscript to be well-written and concise. The results show that the developed products are sufficiently ac- curate within the analysed time period. The only major issue is that the comparison period with MODIS and ERA5 is relatively short, comprising only 4 months in 2023. Because this is shorter than one year, not even the whole seasonal cycle is covered in this comparison. To be more convincing to the readers, the authors should extend the comparison to at least one year. I would appeal to the authors to also publish the code they used for deriving the products. This is unfortunately still not a standard practice with satellite products, but it would help users greatly in understanding the details of the algorithms, reproducibility and scientific advancement. Below I list a number of minor and technical comments.

Kind regards, Dr. Peter Kuma

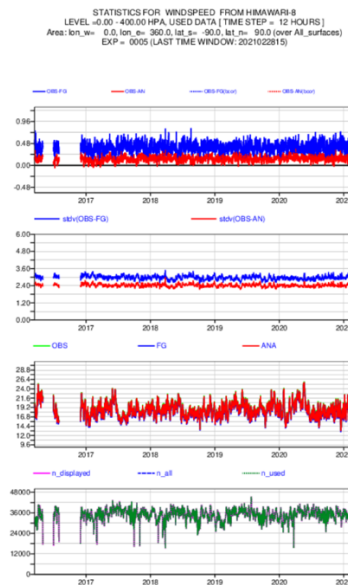
Answer: Thank you for your suggestion. We have downloaded one year (2023) data (MODIS and ERA5) for re-validate our product under your suggestions.

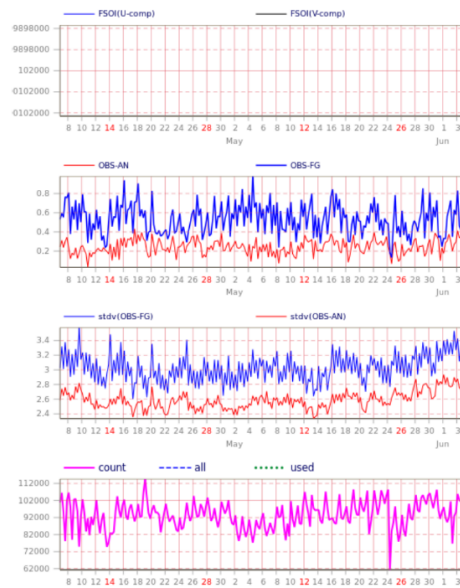
General comments

1. The authors should mention whether ERA5 assimilates data from the Himawari 8 or 9 satellites.

Answer: Thank you for your suggestion. As we known, the atmospheric motion vector (AMV) products of Himawari-8/9 satellites have been assimilated into the ERA5 data, with specific evidence provided below. However, in this study, we do not include AMV product validation.

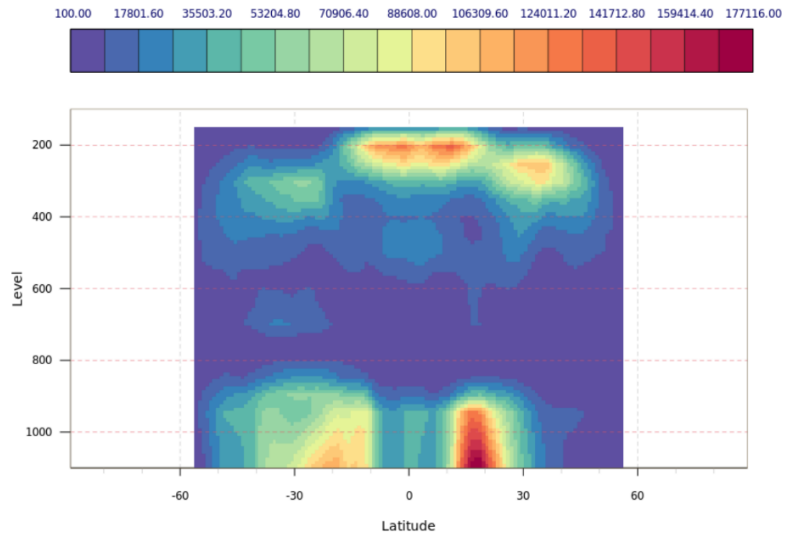
The screenshots and links below provided from the ERA5 official website regarding the assimilation of AMV data from the Himawari-8/9 satellites.

1. Wind speed from HIMAWARI-8 (Time series of area averages)

https://charts.ecmwf.int/catalogue/packages/obstat/products/era5_HIMAWARI-

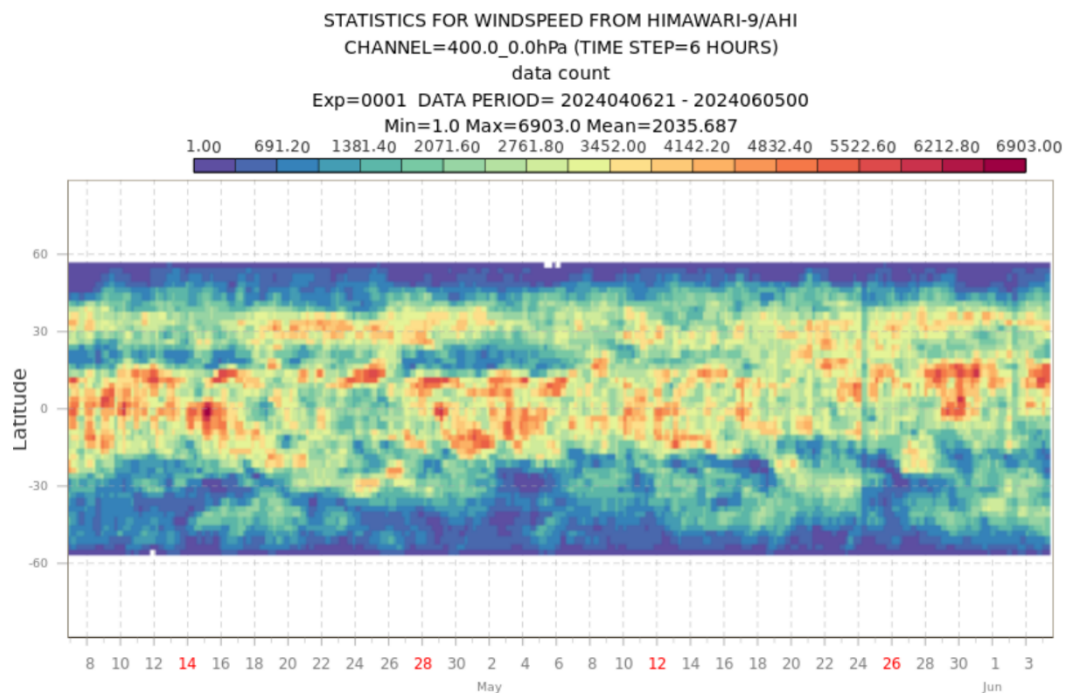
2. Windspeed statistics from HIMAWARI-9

© 2024 European Centre for Medium-Range Weather Forecasts (ECMWF)
Source: www.ecmwf.int
Created at 2024-06-05T13:36:12.084Z

3. Windspeed statistics from HIMAWARI-9

Windspeed statistics from HIMAWARI-9

STATISTICS FOR WINDSPEED FROM HIMAWARI-9/AHI
All layers (TIME STEP=12 HOURS)
data count
Exp=0001 DATA PERIOD= 2024043009 - 2024060500
Min=100.0 Max=177116.0 Mean=21864.967

© 2024 European Centre for Medium-Range Weather Forecasts (ECMWF)
Source: www.ecmwf.int
Created at 2024-06-05T13:38:40.303Z

https://charts.ecmwf.int/catalogue/packages/obstat/products/hovmoller_lev_lat_satob_severi_him9_v1?base_time=202406050000&data_type=count&flag=All&label=FOV_from_satob_0001_LWDA_satob_windspeed_174101_short

4. Windspeed statistics from HIMAWARI-9

Windspeed statistics from HIMAWARI-9

STATISTICS FOR WINDSPEED FROM HIMAWARI-9/AHI
CHANNEL=400.0_0.0hPa (TIME STEP=6 HOURS)
data count
Exp=0001 DATA PERIOD= 2024040621 - 2024060500
Min=1.0 Max=6903.0 Mean=2035.687

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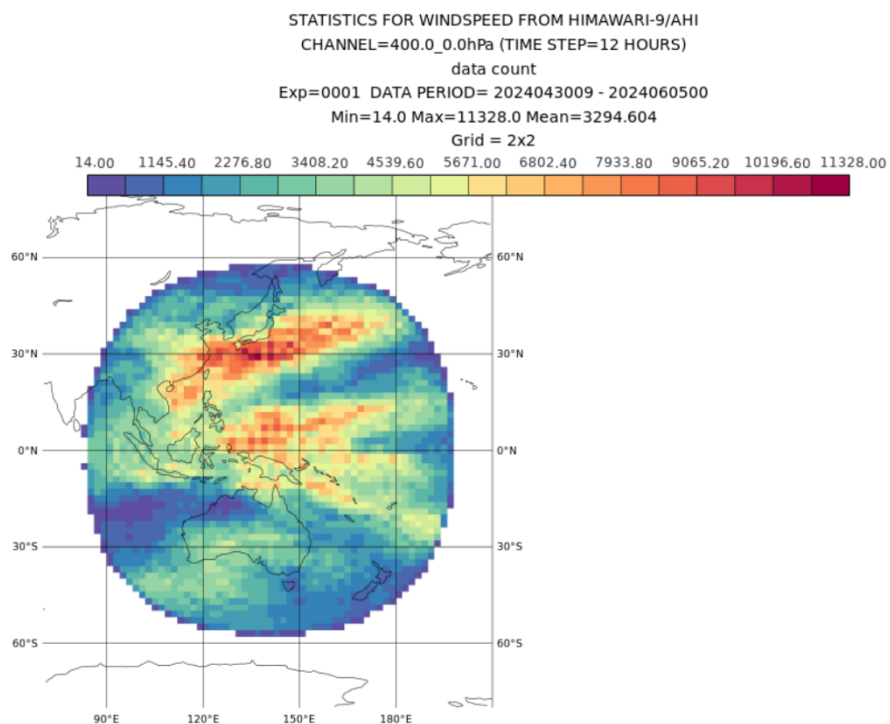
Source: www.ecmwf.int
Created at 2024-06-05T13:41:07.085Z

https://charts.ecmwf.int/catalogue/packages/obstat/products/hovmoller_satob_ahi_him9_v1?base_time=202406050000&data_type=count&flag=All&label=hov_from_satob_0001_LWDA_satob_windspeed_174_short&level=400.0_0.0hPa&satellite=AMV_WVCloudy_ch1

5. Windspeed statistics from HIMAWARI-9

Windspeed statistics from HIMAWARI-9

STATISTICS FOR WINDSPEED FROM HIMAWARI-9/AHI
CHANNEL=400.0_0.0hPa (TIME STEP=12 HOURS)
data count
Exp=0001 DATA PERIOD= 2024043009 - 2024060500
Min=14.0 Max=11328.0 Mean=3294.604
Grid = 2x2

© 2024 European Centre for Medium-Range Weather Forecasts (ECMWF)
Source: www.ecmwf.int
Created at 2024-06-05T13:42:42.106Z

https://charts.ecmwf.int/catalogue/packages/obstat/products/map_satob_ahi_him9_v1?base_time=202406050000&data_type=count&flag=All&label=map_from_satob_0001_LWDA_satob_windspeed_174101_short&level=400.0_0.0hPa

All monitor list URLs:

https://charts.ecmwf.int/catalogue/packages/obstat/?facets=%7B%22Parameter%22:%5B%5D,%22Instrument%22:%5B%22HIMAWARI-9%22,%22HIMAWARI-8%22%5D%7D&_x_tr_hist=true

2. L199: 'which are always used to verify the other congeneric satellite products': Probably not literally 'always'. I suggest 'often'.

Answer: Thank you for your suggestion. We have revised the phrase "which are always used to verify the other congeneric satellite products" to "which are often used to verify the other congeneric satellite products" to more accurately convey our intended meaning.

3. L240: 'AHI9_L2_CLM_20230815_0650_4000M_proj.HDF5': Uppercase 'HDF5' seems to be a fairly un- common extension for HDF5 files. Usually they use '.h5' or '.hdf5' (lowercase) extension. I think this can potentially cause some compatibility problems with programs or libraries the users might use for reading the files.

Answer: Thank you for your suggestion. We have revised the phrase "AHI9_L2_CLM_20230815_0650_4000M_proj.HDF5" to "AHI9_L2_CLM_20230815_0650_4000M_proj.hdf5" to avoid causing compatibility problems with programs or libraries that users might use for reading the files.

4. Equation 11: This should be written more completely with $T(\lambda; 0, p)$ and $T'(\lambda; 0, p)$, instead of $T(0, p)$ and $T'(\lambda)$ (respectively).

Answer: Thank you for your suggestion. We have revised Equation 11 to be more complete by using $T(\lambda;0,p)$ and $T'(\lambda;0,p)$ instead of $T(0,p)$ and $T'(\lambda)$ respectively.

5. Equation 16: '$Ref_{1.6\mu m} - Ref_{0.64\mu m}$': Should this be '$Ref_{0.64\mu m} - Ref_{1.6\mu m}$'?

Equation 17: There is a difference in the bands between this equation and Zheng et al.,

2021 (Equation 4): (G - NIR)/(G + NIR), and in the authors' manuscript it is (R - SWIR)/(R + SWIR).

Answer: Thank you for your suggestion. We have reviewed Equation 16 and confirmed that it should indeed be '$Ref_{0.64\mu m} - Ref_{1.6\mu m}$'. We have made the necessary correction in the manuscript under your advice. I checked, and our program was correct, but the formula was wrong.

There is a difference in the bands between Equation 17 in our manuscript and Equation 4 in Zheng et al., 2021 regarding the G and NIR channels. For the G channel: due to the satellite only having 14 available channels (The real-time data received by the antenna is lack of the 0.47μm and 0.51μm channels (Xia et al., 2023)). We referred to the literature (Gu et al., 2007, see below screenshot) to create a new NDWI. We apologize for previously missing this citation. We have corrected our Equation (17) to NDWI =(Ref0.86μm-Ref2.23μm) / (Ref0.86μm+Ref2.23μm).

Reference:

1. Pan Xia, Min Min, Yu Yu, Yun Wang, Lu Zhang, 2023. Developing a near real-time cloud cover retrieval algorithm using geostationary satellite observations for photovoltaic plants [J]. Remote Sensing, 15(4), 1141, doi: 10.3390/rs15041141

2. Gu, Y., Brown, J. F., Verdin, J. P., & Wardlow, B. (2007). "A five-year analysis of MODIS NDVI and NDWI for grassland drought assessment over the central Great Plains of the United States." Geophysical Research Letters, 34(6).

(3) NDVI and NDWI were calculated according to equations 1 and 2:

$$NDVI = \frac{\rho_{857} - \rho_{645}}{\rho_{857} + \rho_{645}} \tag{1}$$

$$NDWI = \frac{\rho_{857} - \rho_{2130}}{\rho_{857} + \rho_{2130}} \tag{2}$$

From Gu et al., 2007

6. Equation 16–18: References for all of the equations should be provided. For example, the referenced paper Zhang et al. (2021) does not seem to contain a definition of NDSI.

Answer: Thank you for your suggestion. For Equations 16-18, the original manuscript lacked references for NSDI, LSWI and NDWI. We have now included a reference to the paper by Hall et al. (1995) to explain the source of the NDSI equations and a reference to the paper by Xiao et al. (2006) to explain the source of the LSWI equations. Additionally, we also add a reference to the paper by Gu et al. (2007) to explain the source of NDWI equations.

Reference:

1. Hall, D. K., Riggs, G. A., and Salomonson, V. V.: Development of methods for mapping global snow cover using moderate resolution imaging spectroradiometer data, Remote Sensing of Environment, 54, 127-140, 1995.

2. Xiao, X., Boles, S., Frolking, S., Li, C., Babu, J. Y., Salas, W., and Moore, B.: Mapping paddy rice agriculture in South and Southeast Asia using multi-temporal MODIS images, Remote Sensing of Environment, 100, 95-113, https://doi.org/10.1016/j.rse.2005.10.004, 2006.

3. Gu, Y., Brown, J. F., Verdin, J. P., & Wardlow, B. (2007). "A five-year analysis of MODIS NDVI and NDWI for grassland drought assessment over the central Great Plains of the United States." Geophysical Research Letters, 34(6).

7. Table 1: '1=Spare': It is not explained what 'Spare' means. For consistency, it might be better to use the units of K or °C for all temperature quantities.

Answer: Thank you for your suggestion. In the cloud type classification system, "Spare" serves as a placeholder or an unused category. This designation is intended for future use, unexpected conditions, or data that do not fit into predefined cloud type categories. It acts as a buffer or catch-all for any data that cannot be classified under the existing cloud types.

  For consistency, all occurrences of temperature units in the paper have been changed to K. The units of temperature in Table 1 have been corrected as follows:

Table 1. Primary NRT H8/9 GEO satellite atmospheric and oceanic science products and related variables generated by the NANO_SCS system.

Product Name (Abbr.)	Variable Name	Valid Value	Unit	Note
Cloud Mask (CLM)	Cloud_Mask	0=Cloudy; 1=Probably cloudy; 2=Probably clear; 3=Clear	None	
Cloud Fraction (CLF)	Cloud_Fraction	0-100	%	down-sampled 5×5 pixel box
Cloud Type and Phase (CLP)	Cloud_Type	0=Clear; 1=Spare; 2=Liquid water; 3=Supercooled water;	None	

		4=Mixed; 5=Optically thick ice; 6=Optically thin ice; 7=Multilayered ice; 8=Uncertainty		
	Cloud_Phase	0=Clear; 1=Liquid water; 2=Supercooled water; 3=Mixed; 4=Ice; 5=Uncertainty	None	
Cloud Top Properties (CTP)	Cloud_Top_Height	0-30000	m	
	Cloud_Top_Pressure	0-2000	hPa	
	Cloud_Top_Temperature	0-400	K	
	Cloud_Emissivity_at_11μm	0-100	%	
Cloud Optical and Microphysical Properties (COT)	Cloud_Optical_Depth	0-150	None	only daytime
	Cloud_Effective_Radius	0-100	μm	only daytime
	Cloud_Liquid_Water_Path	0-1000	g/m^2	only daytime
	Cloud_Ice_Water_Path	0-1000	g/m^2	only daytime
Cloud Base Properties (CBP)	Cloud_Base_Height	0-30000	m	only daytime
	Cloud_Base_Pressure	0-2000	hPa	only daytime
Sea Surface Temperature (SST)	Sea_Surface_Temperature	0-400	K	
Land Surface Temperature (LST)	Land_Surface_Temperature	0-400	K	
Vegetation/Water Indices (NDI)	NDVI (Normalized Difference Vegetation Index)	0-1.0	None	only daytime
	NDSI (Normalized Differential Snow Index)	0-1.0	None	only daytime
	NDWI (Normalized Differential Water Index)	0-1.0	None	only daytime
	LSWI (Land Surface Water Index)	0-1.0	None	only daytime
Layered Precipitable	Total_Precipitable_Water	0-1000	mm	

Water (LPW)	Water_Vapor_High	0-1000	mm	700-300hPa
	Water_Vapor_Middle	0-1000	mm	900-700hPa
	Water_Vapor_Low	0-1000	mm	Surface-900hPa
	CAPE_Index (Convective Available Potential Energy)	0-10000	J/kg	
	K_Index	-100-100	K	
	LI_Index (Lifted)	0-400	K	Stored in Celsius
	Showalter_Index	0-400	K	Stored in Celsius
	TT_Index (Total totals)	0-400	K	Stored in Celsius

8. Fig. 9: 'AHI09': Label not explained. I guess it is the same as 'H9/AHI' in the text?

Answer: Thank you for your suggestion. We have updated 'AHI09' in Fig. 9 to 'H9/AHI' accordingly.

Technical comments

1. 'clear sky', 'clear-sky', 'cloud sky', 'cloudy-sky': These should be used consistently with or without hyphen everywhere in the text.

Answer: Thank you for your suggestion. We have standardized the usage of the following terms, changing all instances of 'clear sky' and 'cloud sky' to 'clear-sky' and 'cloudy-sky'.

2. L98: 'Except to GEO advanced imager': 'Apart from a GEO advanced imager'?

L51, L173: 'boasting': I suggest using a more neutral word.

Answer: Thank you for your suggestion. Reviewer 2 brought up a similar concern. Therefore, we have modified "Except to GEO advanced imager" to "In addition to

GEO advanced imager." Additionally, we have adjusted "boasting" in Line 51 to "with," and "boasts" in Line 173 to "has."

3. L163: 'to product': 'to produce'.

Answer: Thank you for your suggestion. We have modified "to product" in Line 163 to "to produce."

4. L188: '1999 and 2022': '1999 and 2022 (respectively)'.

Answer: Thank you for your suggestion. We have modified "1999 and 2022" in Line 188 to "1999 and 2022 (respectively)".

4. L204, L212: '(Min et al., 2017b)': This should be without parentheses.

Answer: Thank you for your suggestion. We have modified "(Min et al., 2017b)" in Line 204 and Line 212 to "Min et al., 2017b".

6. L213: 'retrieve': 'retrieving'.

Answer: Thank you for your suggestion. We have modified "retrieve" in Line 213 to "retrieving".

7. L327: 'it can describe': 'It can describe'.

Answer: Thank you for your suggestion. We have modified "it can describe" in Line 327 to "It can describe".

8. L334: 'Parol et al., (1991) demonstrated the a good approximation': 'Parol et al. (1991) demonstrated a good approximation' (extra comma and 'the').

Answer: Thank you for your suggestion. We have modified "Parol et al., (1991) demonstrated the a good approximation" in Line 334 to "Parol et al. (1991) demonstrated a good approximation".

8. L423: 'in general circulation model (GCM)': 'in a general circulation model (GCM)' or 'in general circulation models (GCMs)'.

Answer: Thank you for your suggestion. We have modified "in general circulation model (GCM)" in Line 423 to "in a general circulation model (GCM)".

9. L458: 'We find the consistent retrieval results': 'We find consistent retrieval results'.

Answer: Thank you for your suggestion. We have modified "We find the consistent retrieval results" in Line 458 to "We find consistent retrieval results".

11. L474: 'products in Sections 3.6 and 3.7': 'products described in Sections 3.6 and 3.7'.

Answer: Thank you for your suggestion. We have modified "products in Sections 3.6 and 3.7" in Line 474 to "products described in Sections 3.6 and 3.7".

12. L552: 'we find the consistent results': 'we find consistent results'.

Answer: Thank you for your suggestion. We have modified "we find the consistent results" in Line 552 to "we find consistent results".

13. L587: 'smlweix (sml#456@)': It is not clear from the text that this is the FTP login and password. The PDF document on Figshare also mentions a particular FTP port, which is not mentioned here.

Thank you for your suggestion. We have clarified the FTP login, password, and port. The corresponding section of the article has been revised as follows: "Data can be downloaded via FTP (File Transfer Protocol) using the address FTP://www.hellosea.org.cn:10021, with the login credentials being 'smlweix' and the password 'sml#456@'.

14. L594: '0° longitude': '0° latitude'.

Answer: Thank you for your suggestion. We have modified "0°longitude" in Line 594 to "0°latitude".

15. L600: 'NANO_system': 'NANO_SCS system' to be consistent with the rest of the text. Fig. 2, 3, 6–10: Make sure that all plot labels are large enough to be readable.

Answer: Thank you for your suggestion. We have adjusted all instances of "NANO_system" to maintain consistency with "NANO_SCS system". Additionally, we have resized Fig. 2, 3, 6–10 to ensure that all plot labels are large enough to be easily readable.

16. Fig. 5, 6, 9: The use of jet colormap is not suitable for colour blind readers.

Answer: Thank you for your suggestion. We have did our best to adjust the colormap to ensure it is suitable for color blind readers. You can find the changes of Figures 5,6,9 in our new manuscript.

Reviewer#2

General comments:

In this manuscript, the authors present a near real-time dataset covering a series of atmospheric and oceanic products generated from Himawari-8/9 geostationary satellite observations over South China Sea. Descriptions are provided succinctly for each of the algorithms used to generate the products, and validations against MODIS and ERA5 products are also carried out. This dataset is comprehensive and useful for numerical weather forecasting, marine environmental monitoring, as well as academic research, making it of good value to be published. The writing of this manuscript, however, needs improvement as there are numerous grammatical errors and misused words. It is strongly recommended that the authors send the manuscript to a native speaker for thorough proofreading to enhance its quality. Apart from this, this work is of good quality and significance, and I recommend it to be published in ESSD after minor revisions.

Answer: Thank you for your constructive feedback. We appreciate your acknowledgment of the comprehensive nature and utility of our dataset. Following your recommendation, we have thoroughly proofread the manuscript and corrected the grammatical errors and misused words. We believe these revisions have significantly improved the clarity and readability of the text.

Specific comments:

1. Line 87 on Page 3, 'used for examine' should be 'used to examine', also maybe 'identify' instead of 'examine'?

Answer: Thank you for your suggestion. We have corrected "used for examine" to "used to examine" in Line 87 on Page 3 and have also replaced "examine" with

"identify" for clarity.

2. Line 98 on Page 4, 'Expect to GEO imager', do you mean 'In additional to'?

Answer: Thank you for your suggestion. We have modified "Expect to GEO imager" to "In additional to GEO imager" in Line 98 on Page 4.

3. Line 99-100 on Page 4, 'hyperspectral sounder detection sensors' should be 'hyperspectral sounding detection sensors'.

Answer: Thank you for your suggestion. We have modified "hyperspectral sounder detection sensors" to "hyperspectral sounding detection sensors" in Line 99-100 on Page 4.

4. Line 100-101 on Page 4, plural forms should be used as 'thunderstorms, lightning activities, atmospheric temperature and humidity profiles, and even wind fields'.

Answer: Thank you for your suggestion. We have modified plural forms to "thunderstorms, lightning activities, atmospheric temperature and humidity profiles, and even wind fields" in Line 100-101 on Page 4.

5. Line 129-130 on page 5, should be 'Section 3 shows some sample results and verification of key science products in terms of accuracy and reliability'.

Answer: Thank you for your suggestion. We have revised Lines 129-130 on Page 5 to: "shows some sample results and verification of key science products in terms of accuracy and reliability."

6. Line 163 on Page 6, 'to product data' should be 'to produce data'.

Answer: Thank you for your suggestion. We have modified "to product data" to "to produce data" in Line 163 on Page 6.

7. Line 173 on Page 6, should be '(NWP) data from GFS as ancillary data'.

Answer: Thank you for your suggestion. We have revised Lines 173 on Page 6 to: "(NWP) data from GFS as ancillary data"

8. Line 173 on Page 6, 'boasts' doesn't fit well here as it seems like an excessive pride talking about it. Words like 'has' might be better.

Answer: Thank you for your suggestion. We have modified "boasts" to "has" in Line 173 on Page 6.

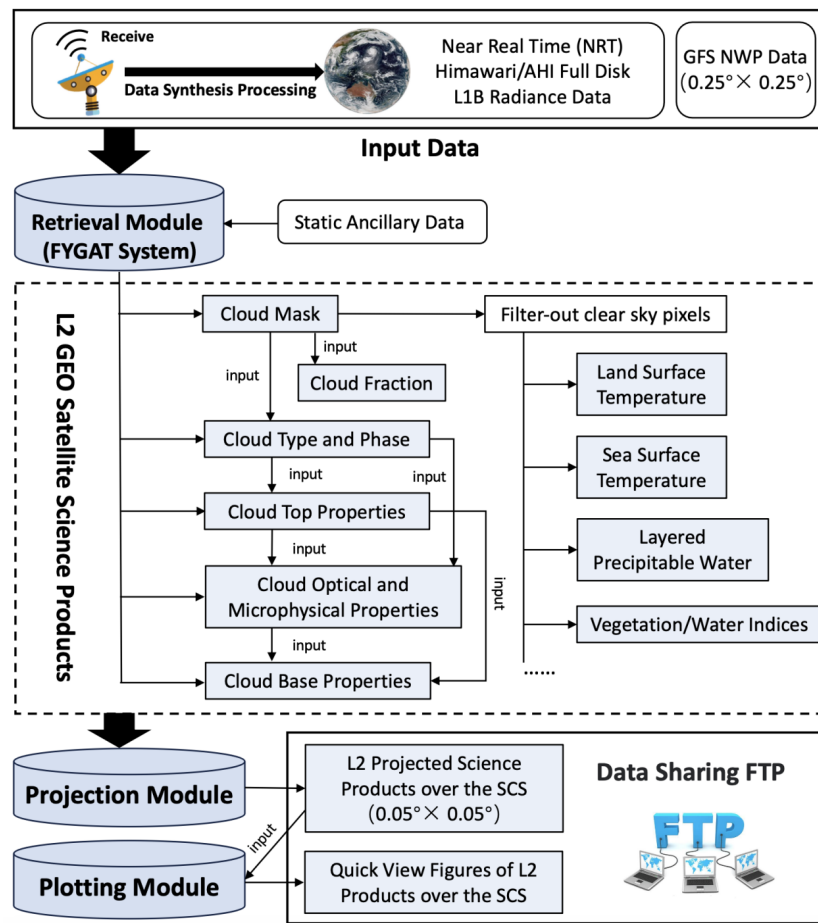
9. Line 183 on Page 6, should be 'four months of Climate Data Records'.

Answer: Thank you for your suggestion. We have revised Lines 183 on Page 6 to: "four months of Climate Data Records"

10. Line 194 on Page 7, does ERA5 assimilate observations from AHI on Himawari satellites? Authors should clarify. If data already assimilated, then it's not an independent source of validation, although it may still function as a verification on calculation accuracy of algorithm.

Answer: Thank you for your suggestion. For detailed information on this issue, please refer to our response to Reviewer 1's question No. 1.

11. Figure 1. Recommend 'Plotting Module' instead of "Drawing Module", and 'Filter-out' instead of 'Pick-up'.

Answer: Thank you for your suggestion. We have revised Figure 1 to use 'Plotting Module' instead of 'Drawing Module', and 'Filter-out' instead of 'Pick-up'. The revised figure is shown below:

New Figure 1. Flowchart of the NANO_SCS system. Dark gray shading represents key processing module; light gray shading represents satellite science product.

12. Line 337-338 on Page 11. 'consider' should be 'considers', and 'provide' should be 'provides'.

Answer: Thank you for your suggestion. We have revised Line 337-338 on Page 11 to use 'considers' instead of 'consider', and 'provides' instead of 'provide'.

13. Line 356 on Page 11, 'POD)' should be 'POD'.

Answer: Thank you for your suggestion. We have revised Line 356 on Page 11 to use 'POD)' instead of 'POD'.

14. Line 373 on Page 12, Eq.2 is for cloud type and phase (CLP) retrieval according to Section 3.2.

Answer: Thank you for your suggestion. We have revised Line 373 on Page 12 to use 'CLP' instead of 'CTP' according to Section 3.2.

15. Line 499-502 on Page 16, the quantitative applications of LI should have some citations.

Answer: Thank you for your suggestion. We have added references for the quantitative applications of LI in Lines 499-502 on Page 16. The added references are as follows:

Reference:

Fernando, M., Millangoda, M., and Premalal, S.: Analyze and Comparison of the Atmospheric Instability Using K-Index, Lifted Index Total Totals Index Convective Availability Potential Energy (CAPE) and Convective Inhibition (CIN) in Development of Thunderstorms in Sri Lanka During Second Inter-Monsoon, Multi-Hazard Early Warning and Disaster Risks, Cham, 2021//, 603-614,

16. Line 578 on Page 18. 'It mainly providing' should be 'It mainly provides'.

Answer: Thank you for your suggestion. We have revised Line 578 on Page 18 to use 'It mainly providing' instead of 'It mainly provides'.

17. Line 580 on Page 18, 'within a temporal resolution' should be 'with a resolution'.

Answer: Thank you for your suggestion. We have revised Line 580 on Page 18 to use 'within a temporal resolution' instead of 'with a resolution'.

18. Line 576-577 on Page 18, it is confusing since the Himawari-8/9 satellites were launched and in operation long before Nov. 3, 2022.

Answer: Thank you for your suggestion. We have revised the manuscript to separately specify the launch dates of H8 and H9. The revised text in the manuscript is as follows: "The Japanese Himawari-8 (H8) and Himawari-9 (H9) geostationary (GEO) satellites are strategically positioned over the South China Sea (SCS), having been launched on October 7, 2014, and November 2, 2016, respectively."

19. Line 591 on Page 18, 'NANO system' should be 'NANO_SCS system' for consistency.

Answer: Thank you for your suggestion. We have revised Line 591 on Page 18 to use 'NANO_SCS system' instead of 'NANO system' for consistency.